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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to secondary science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet outlines activities designed to introduce students to weather instruments. The estimated time for completing the activities in this module is two weeks. (SL)

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Weather

AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE

ED130894

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EDUCATION & WELFARE
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MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1974

Marvin G. Spencer

SE 021 636

WEATHER INSTRUMENTS

Prepared by

John Fradiska

Estimated Time for Completion

2 weeks

Frederick County Board of Education

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Mini Courses for

Physical Science, Biology, Science Survey, Chemistry and Physics

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1974

FOREWORD

The writing of these instructional units represents Phase II of our science curriculum mini-course development. In Phase I, modules were written that involved the junior high disciplines, life, earth and physical science. Phase II involves senior high physical science, biology, chemistry, physics and science survey.

The rationale used in the selection of topics was to identify instructional areas somewhat difficult to teach and where limited resources exist. Efforts were made by the writers of the mini-courses to relate their subject to the practical, real world rather than deal primarily in theory and model building.

It is anticipated that a teacher could use these modules as a supplement to a basic curriculum that has already been outlined, or they could almost be used to make up a total curriculum for the entire year in a couple of disciplines. It is expected that the approach used by teachers will vary from school to school. Some may wish to use them to individualize instruction, while others may prefer to use an even-front approach.

Primarily, I hope these courses will help facilitate more process (hands on) oriented science instruction. Science teachers have at their disposal many "props" in the form of equipment and materials to help them make their instructional program real and interesting. You would be remiss not to take advantage of these aids.

It probably should be noted that one of our courses formerly called senior high physical science, has been changed to science survey. The intent being to broaden the content base and use a multi-discipline approach that involves the life, earth and physical sciences. It is recommended that relevant topics be identified within this broad domain that will result in a meaningful, high interest course for the non-academic student.

ALFRED THACKSTON, JR.
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WEATHER INSTRUMENTS

A. Thermometer

The thermometer is a weather instrument used to detect hour-to-hour changes in the temperature of the air. The temperature of the air is an important factor in making an accurate weather forecast.

OBJECTIVES

The student will be able to:

1. name the instrument used in measuring air temperature.
2. identify two types of thermometers
3. distinguish between a degree Celsius and a degree Fahrenheit.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Earth Science, The World We Live In, 3rd edition, by Namowitz and Stone, 1965, Section 17, Measuring Air Temperature, pages 440-441

or

2. Pathways in Science 2, Oceans of Air and Water, by Oxenhorn, page 50, Section 3, Heat and Thermometers

b. Complete Worksheet #1, Thermometer

Worksheet #1

THERMOMETER

1. Explain how the thermometer is used in the study of weather.

2. List different types of thermometers.

3. Explain how the liquid thermometer operates (how it works).

4. Make a drawing of a liquid thermometer and label the basic parts.

5. Explain the operation of the maximum and minimum thermometer and its importance to weather forecasting.

OBJECTIVE

The student will be able to:

4. label a diagram of the liquid thermometer and explain its operation.

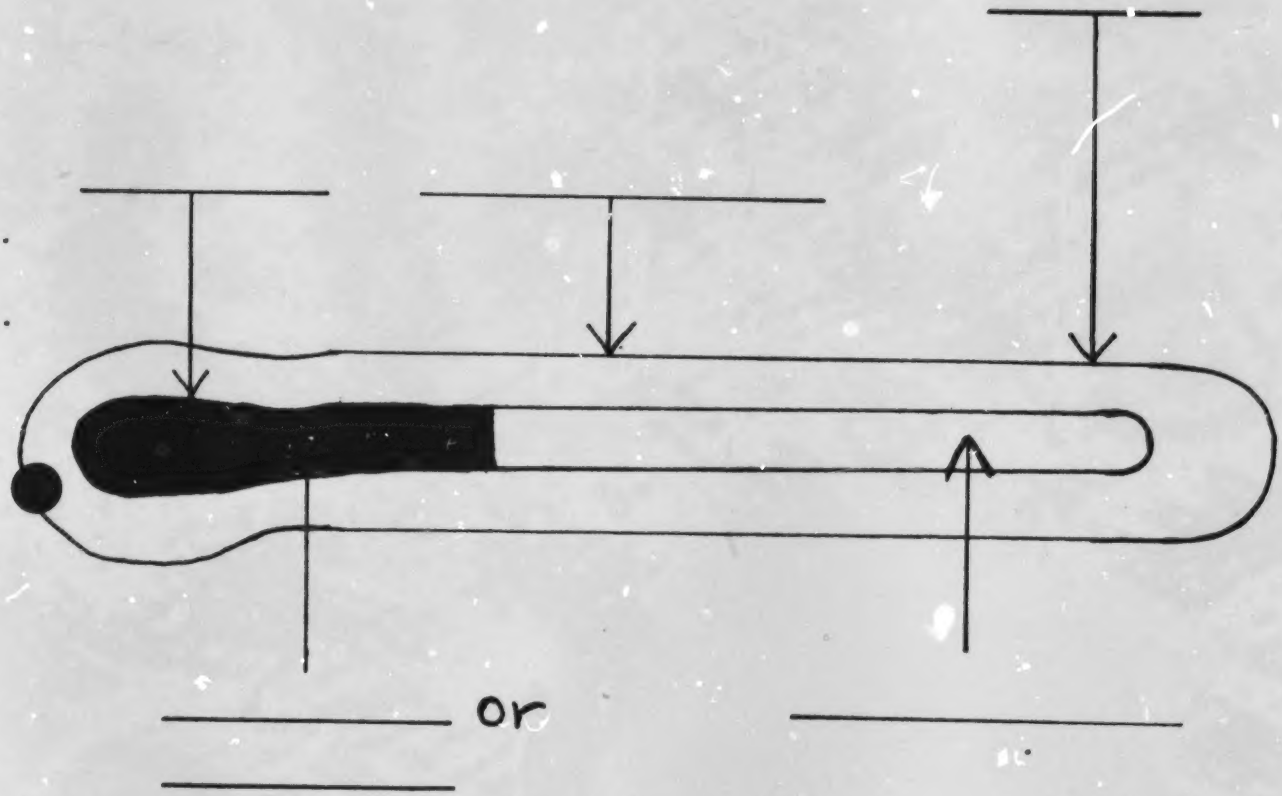
ACTIVITIES

a. Study Figure 31-10, Earth Science, The World We Live In, 3rd edition by Namowitz and Stone, 1965

b. Complete Worksheet #2, Label the Parts of a Liquid Thermometer.

Worksheet #2

LABEL THE PARTS OF A LIQUID THERMOMETER



_____ or _____

_____

OBJECTIVE

The student will be able to:

5. construct an air thermometer.

ACTIVITY

a. Complete the Lab Sheet, Air Thermometer

Lab Sheet

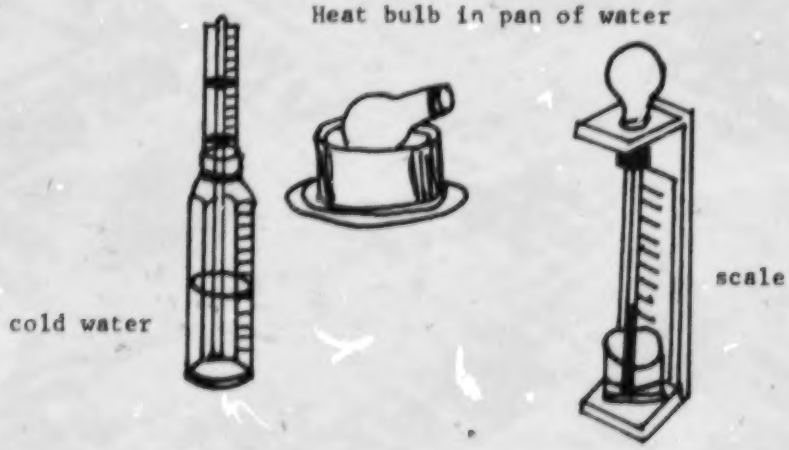
AIR THERMOMETER

Purpose: A thermometer is used to measure temperature, or the heat energy of air molecules. The one you are about to make is the same kind that Galileo, an Italian scientist, made over 350 years ago.

Materials: Light bulb or baby bottle, one-hole rubber stopper, glass tubing about 1½' long, and a pan holding water

What to Do: You can make either of two kinds of air thermometers. The easiest to make is the one with the baby bottle or bulb on the bottom. If you use an old light bulb, remove the inside of the bulb as explained in the light bulb chemistry flask section, (see page 5). Fill the bulb or bottle about half full of cold water. Put some food coloring or ink in the water. Insert the glass tubing through the stopper and all the way into the bulb or baby bottle. Insert the stopper as shown. Place a cardboard scale on the back of the tubing and hold it in place with Scotch tape. You can calibrate the scale later by comparing your readings with that of a regular thermometer. As the water in the bulb warms up to room temperature, it warms the air in the bulb. The air molecules move faster and push harder on the water. This pushes the water up the tube.

A second type of air thermometer has an inverted bulb. Heat the bulb so that some of the air will leave the bulb. Quickly insert the rubber stopper in the bulb or bottle, and stick the other end of the tubing in a pan or jar containing colored water. As the air in the bulb cools, the molecules don't move as fast, and the water pushes part way up the tube. Fix a stand to hold the bulb or bottle and again attach cardboard for a scale.



Operation of Equipment: After the air or water has reached room temperature, make a mark on the scale for the height of the liquid. Use another thermometer to give you the correct reading and mark it on the scale. Try your thermometer with different room and out-door temperatures. Again calibrate with readings from a standard thermometer.

Can You Work like a Scientist?

1. Does air pressure affect your readings? Which thermometer would be the most accurate?

2. Try your thermometer directly in the sun. Is it accurate under direct sunlight? Check with a standard thermometer.

3. How high up a tube can you make the water climb by heating the air?

OBJECTIVE

The student will be able to:

6. calculate the daily temperature range.

ACTIVITY

a. Obtain temperature data for a twenty-four hour period from a newspaper or t.v. weather forecast. Now using an earth science textbook, define daily temperature range and calculate the daily temperature range.

B. Hygrometer

If you feel hot and the weather is getting you down, it may be due to a high hygrometer reading.

OBJECTIVES

The student will be able to:

7. name the instruments used in determining the relative humidity.

8. identify the types of hygrometers.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Pathways in Science 2 by Oxenhorn, page 90, Section 5, Measuring Humidity, page 62, Section 2, It's Muggy Today!

2. Earth Science, The World We Live In, Namowitz and Stone, third edition, Chapter 34, pages 476-479, Sections 5-7

3. Modern Earth Science, pages 427-429

b. Complete Worksheet #3, Hygrometer.

Worksheet #3

HYGROMETER

1. Name the instrument used in determining the relative humidity.

2. List the different types of hygrometers used in determining the relative humidity.

3. Name the units used in measuring the relative humidity.

4. Describe the procedure for determining the relative humidity. (Section 6, pages 477-478, Namowitz and Stone, or see your teacher)

5. Define or explain:

   a. humidity

   b. relative humidity

   c. evaporation

   d. saturated

   e. condensation

OBJECTIVE

The student will be able to:

9. construct a hair hygrometer and gather data in relation to the humidity.

ACTIVITY

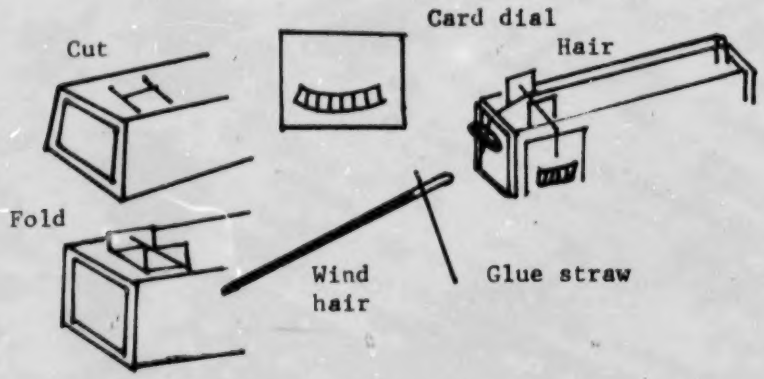
a. Complete the Hair Hygrometer Lab Page.

HAIR HYGROMETER

Purpose: A hygrometer measures the humidity of moisture in the air.

Materials: Two paper clips, milk bottle carton, needle with a large eye, a human hair about ten inches long, glue or cement, broom straw, and a blank file card (any cardboard will do).

What To Do: Wash the hair in alcohol or soapy water to remove the oil. The oil coats the hair and keeps it from absorbing moisture. Rinse and allow the hair to dry completely. Cut two flaps near one end of the carton. Make two holes as shown. Work the needle back and forth in the holes so that the needle turns easily. Cut a slot for a paper clip at the other end of the carton. Stick the end of the straw through the eye of the needle. Glue or cement the straw in place. Make a dial on your file card as shown. You can hold the file card in place with Scotch tape or tacks. Slip one end of the hair into the paper clip and place the clip in the slot. Do not touch the hair with your bare hand as you will get oil on it. Slip the needle in place and then wrap one turn of the hair around the needle. Slip the other end of the hair into the second paper clip. Hang this clip over the end of the carton.



Can You Work Like A Scientist?

1. What is the humidity when you take a shower?
2. Does the humidity change when there are many people in a room?
3. What effect does humidity have on static electricity?

OBJECTIVE

The student will be able to:

10. construct a wet-and dry-bulb hygrometer.

ACTIVITY

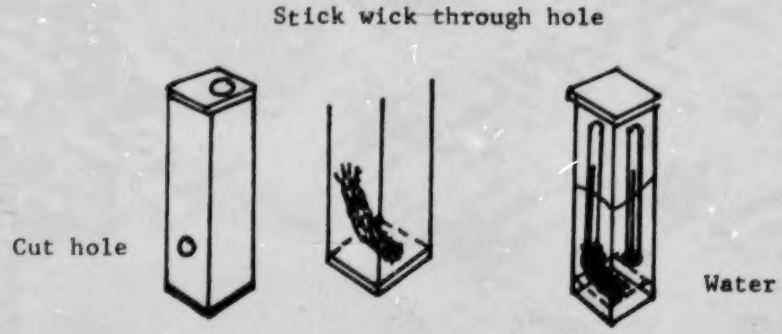
a. Complete the Lab Sheet, Wet- and Dry-Bulb Hygrometer

WET- AND DRY-BULB HYGROMETER

Purpose: This instrument is used to measure both the temperature and the amount of moisture in the air.

Materials: Two thermometers, milk bottle carton, two rubber bands, and a piece of clothesline rope about 5" long. The thermometers should read alike, and the bulb should not be covered. Thermometers with cardboard backs are ideal. The clothesline rope should be the kind with soft cotton fibers inside.

What To Do: Cut a hole about three inches from the bottom of the carton. Stick the clothesline rope through the hole so only about one inch sticks out. Slip this end over one of the thermometer bulbs. Fasten the thermometers to the outside of the carton with rubber bands. Pour about two inches of water into the carton.



Operation of Equipment: The fine hairlike strands in the cotton rope suck up the water. Soon the water will climb up the rope and dampen the bulb of the "wet" thermometer. In order to understand what happens, wet the back of your hand. Blow across it. The water on your hand evaporates, and your hand seems cooler. This is what happens to the wet bulb thermometer. The rate or speed of evaporation depends on how much water is in the air and the temperature of the air. To use this instrument, fan the wet bulb with a piece of cardboard. Check the temperature. Note the temperature of the dry thermometer and the difference in temperatures between the two thermometers. Use this information with your humidity chart to find the relative humidity (amount of moisture in the air compared to the amount that the air could hold at that temperature). The relative humidity is given as a per cent.

Can You Work Like A Scientist?

1. Place a drop of water and a drop of alcohol on the back of your hand. Blow across each. Which feels cooler? Which one evaporates quicker? What has the rate of evaporation to do with cooling?

2. Note the readings on your thermometers when you use water. Then, instead of water, use alcohol. Could you make a humidity chart based on the evaporation of alcohol?

3. Try your gauge in the bathroom when someone is taking a shower. As the humidity increases, what happens to the mirror?

4. How is humidity related to temperature? What effect does wind have on your wet- and dry-bulb hygrometer?

C. Barometer

If you could select only one instrument to be used in weather prediction, the barometer would be the best instrument. Do you know why?

OBJECTIVES

The student will be able to:

11. name the instrument used for determining air pressure.

12. identify the types of barometers.

13. explain the differences between the mercury barometer and the aneroid barometer.

14. identify the individual that developed the mercurial barometer and describe his experiment.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Earth Science, The World We Live In by Namowitz and Stone, third edition, pages 449-453, Sections 1-6

2. Pathways in Science 2 by Oxenhorn, Chapter 2, How We Measure Air Pressure, pages 29-33

3. Modern Earth Science, 1969 edition, by Ramsey, pages 409 and 410

b. Complete Worksheet #4, Barometer.

Worksheet #4

BAROMETER

Student Note: Complete your reading assignment before starting this study sheet.

1. Name the instrument used in measuring air pressure.

2. List the different types of barometers.

3. Explain the operation and importance of the recording barometer (barograph).

4. Identify the units involved with the barometer and weather reporting.

5. Define or explain:

   a. air pressure

   b. altimeter

   c. Torricelli

OBJECTIVE

The student will be able to:

15. construct a balloon barometer and measure changes in air pressure.

ACTIVITY

a. Complete the Balloon Barometer Lab Page.

BALLOON BAROMETER

Purpose: To construct a barometer and measure changes in air pressure.

Materials: 2 baby food jars, balloon, plastic straw, 3 rubber bands, tape, and a tongue depressor

Procedure:

A. Cut the balloon down the middle so as to obtain the maximum surface area for covering the top of one baby food jar.

B. Attach the balloon to the top of a baby food jar by means of rubber bands. (see diagram A)

C. Fasten the plastic straw to the balloon with a piece of tape.

D. Next cut the other end of the straw at an angle to make it pointed.

E. Now attach the tongue depressor to the other baby food jar by means of two rubber bands. (see diagram A)

Lab Set Up:

A. Set the barometer at some location within your classroom and mark the tongue depressor at a zero point.

B. For a period of 5 days record changes in the air pressure using your barometer.

Results:

Air Pressure Data

Date	Air Pressure

Conclusion Questions:

1. Can you measure changes in air pressure with your barometer?

2. If the air pushes more on the center of the balloon, in which direction will the end of the plastic straw move?

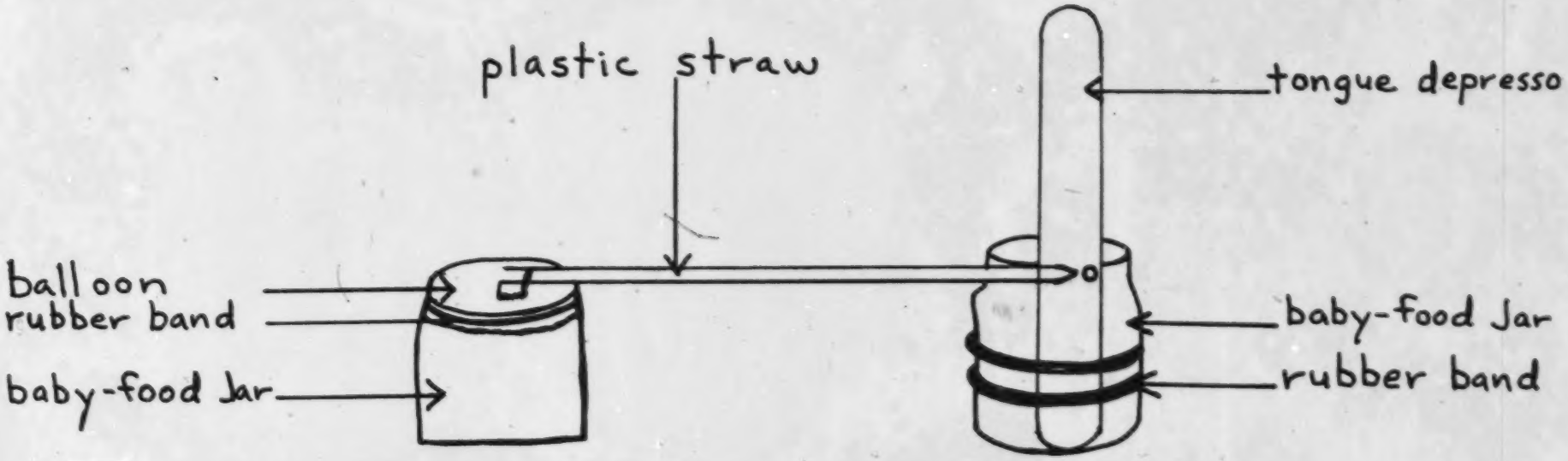
3. Did the air pressure change during the 5 days of observation?

4. If there was a change in air pressure during your 5 days of observation, how did the weather change?

5. Your barometer is similar to or like which type of barometer?

BALLOON BAROMETER LAB

(Diagram A)



D. Rain Gauge

If we had an extreme amount of rainfall, a rain gauge could predict or determine a flood or flash flood watch.

OBJECTIVES

The student will be able to:

16. identify the weather factor measured by a rain gauge.

17. explain the use and operation of a rain gauge.

18. name the measuring units that are related to the rain gauge.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Pathways II by Oxenhorn, pages 90-91, Section 6, Measuring Rainfall

2. Earth Science, The World We Live In, page 494, Section 3, Measuring Precipitation

b. Complete Worksheet #5, Rain Gauge.

Worksheet #5

RAIN GAUGE

1. Name the weather factor measured by a rain gauge.

2. Explain the operation (how it works) of a rain gauge.

3. Name the units that are related to the rain gauge.

OBJECTIVE

The student will be able to:

19. construct a rain gauge and measure the rainfall for a period of one week.

ACTIVITY

a. Complete the Lab Sheet, Rain Gauge.

Lab Sheet

RAIN GAUGE

Purpose: A rain gauge is used to measure the amount of rainfall over a period of time, for instance, 24 hours. The difficulty in measuring rainfall is that it seldom rains enough to be measured accurately with a ruler. Rainfall is usually measured in hundredths of an inch. This rain gauge magnifies the readings, so that the amount is measurable.

Materials: Baby bottle, milk bottle carton, and a three-inch funnel

What To Do: Cut a slot about ½ inch wide down the middle of one side of the carton. Fasten a piece of adhesive tape along this slot. This will serve as your measuring scale. Cut out part of the top of the carton so you can slip a baby bottle into it. Then a funnel is placed on top of the carton so that the rain, going into the funnel, will drain into the baby bottle.

1" mason jar = 170 cc baby bottle

Operation of Equipment: The funnel is larger than the baby bottle in diameter, so an inch of rain going into the funnel will be much deeper than an inch in the baby bottle. The large funnel and the small baby bottle magnify the reading. In order to place accurate measurements on the scale, we must find out how high one inch of rain through the funnel will show in the baby bottle. To do this, we need a bottle whose opening is the same size as the funnel. Then one inch of water in this bottle would be equal to one inch of rainfall going through the funnel. We then pour this water into the baby bottle and mark the heighth as one inch. A wide-mouth mason jar has the same opening as a three-inch funnel. One inch of water in this jar when poured into the baby bottle comes up to 170cc. Mark 1" on the tape at this spot. Divide the inch into tenths. These tenths can be redivided into ten parts so your rain gauge will measure hundredths of an inch.

Can You Work Like A Scientist?

1. How can you magnify your readings more?

2. Can you keep a chart of rainfall for the month and record the rainfall each day? On what day does it rain the most?

3. Can you compare months with each other? In what month does it rain the most?

4. Does it rain as much at a friend's house many miles away as it does at your house? Does it rain as much in the country as the city?

E. Anemometer

How fast is the weather moving?

OBJECTIVES

The student will be able to:

20. name the instrument used to determine the speed of the wind.

21. explain the use and operation of the anemometer.

22. list the units used to record the speed of the wind.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Pathways II by Oxenhorn, pages 89-90, Section 4, Winds: Where and How Fast?

2. Earth Science, The World We Live In, pages 458-459, Section 17, Observing the Wind

b. Complete Worksheet #6, Anemometer.

Worksheet #6

ANEMOMETER

1. Name the instrument used to determine the speed of the wind.

2. Explain the use and operation of the anemometer.

3. List the units used to record the speed of the wind.

4. Explain or define:

   a. knot

   b. wind

   c. wind vane

OBJECTIVE

The student will be able to:

23. construct an anemometer and measure the wind speed.

ACTIVITY

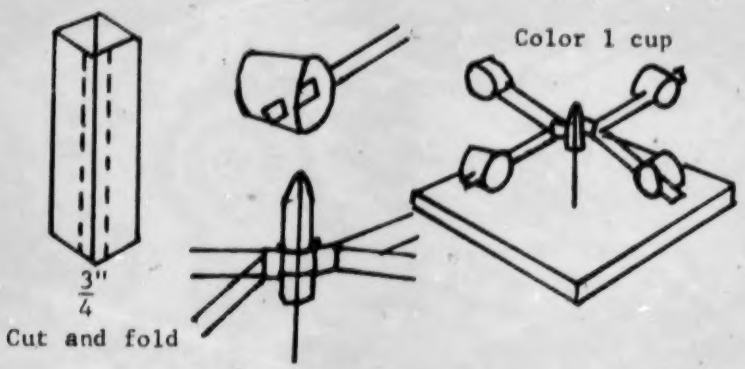
a. Complete the Lab Sheet, Anemometer.

ANEMOMETER

Purpose: The anemometer is used to measure wind speed from any direction. The weather bureau uses one with three cups. As these cups turn, a dial connected electrically to the anemometer shows the wind speed to the weatherman inside the weather station.

Materials: Milk bottle carton, four paper cups, medicine dropper or short piece of glass tubing, staples or paper clips, and a board with a large nail for the base.

What to Do: Cut the four corner strips off a milk carton as shown with the dotted lines. Slip the folded ends of each pair of strips together. This should make two long strips. Lay one of the long strips on the table. Place the glass part of an eyedropper or a sealed end of a piece of glass tubing on the middle of the long strip. Lay the other long strip over the top of the eyedropper and fasten the two strips around the eyedropper with staples or paper clips. Bend the four arms out as shown. Cut a slot in each of the four paper cups and insert the end of one arm in each cup. Drive a spike through a piece of board and then drop the eyedropper over the end of the spike so that the cups will turn freely on the spike. This wooden base can be nailed to the top of a post outside. Color or mark one cup so that it is easy to see.



Operation of Equipment: In order to measure the wind speed, count the number of turns in 30 seconds and divide by five. This will give you the wind speed in miles per hour. Each anemometer is a little different. A more accurate way to calibrate the wind speed is to take a ride in a car on a calm day. Stick your anemometer out the car window and count how many times it turns in 30 seconds at, say, 5 miles an hour. Then count the number

of turns when the speedometer shows ten miles an hour. You can do this for any speed and make an accurate table.

Can You Work Like A Scientist?

1. Can you think of a way you could connect up your anemometer to show the speed electrically on a dial?

2. What area near your home or school is the windiest? The calmest?

3. How does the wind vary for you and your friend who lives several miles away?

4. What has wind speed to do with humidity (remember your hygrometer)?

5. What month of the year is the windiest? (keep a chart for several months)

6. How does your knowledge of wind speed help you predict weather?

7. With your wind-chill chart can you use your anemometer to help you decide what kind of clothes to wear to school?

F. Wind Vane

Wind vanes come in a variety of shapes and they are located in some rather unique places. Can you name a unique location for a wind vane?

OBJECTIVES

The student will be able to:

24. name the instrument used to determine wind direction.

25. explain how the wind is given a name by the weatherman.

ACTIVITIES

a. Complete one of the following reading assignments.

1. Earth Science, The World We Live In, pages 458, 459, Section 17, Observing the Wind

2. Modern Earth Science, 1969 edition, page 454, Section 4, Wind Speed and Direction

b. Complete Worksheet #7, Wind Vane.

Worksheet #7

WIND VANE

1. Name the instrument used to determine wind direction.

2. Explain how the wind is given a name by the weatherman.

3. Explain why the wind direction is an important factor in weather prediction.

4. Name the general wind direction for Frederick County.

OBJECTIVE

The student will be able to:

26. construct a wind vane.

ACTIVITY

a. Complete the Lab Sheet, Wind Vane.

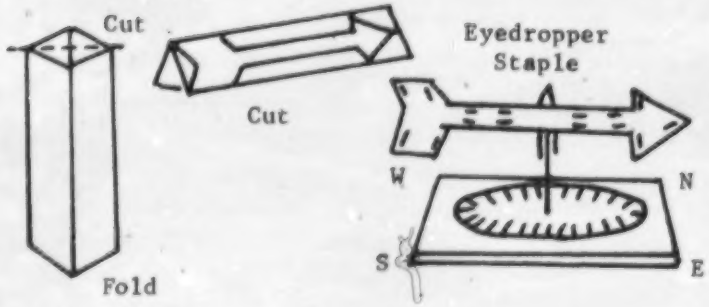
Lab Sheet

WIND VANE

Purpose: The wind vane detects the direction from which the wind is blowing close to the surface of the ground.

Materials: Milk bottle carton, paper clips or staples, short piece of glass tubing or an eyedropper, spike, and wood for the base.

What to Do: Cut off a corner strip of the carton as shown. Shape the cardboard into an arrow. Be sure the tail is very large. Seal the end of a short piece of glass tubing or use a medicine dropper. Place the tubing between the double shaft of the arrow and keep it in position with staples or paper clips. The base to hold the wind vane can be a large nail (spike) driven through a board.



Operation of Equipment: You can use the wooden base with your wind vane almost any place. Just set the glass tubing or medicine dropper over the nail. This type of base can also be mounted on the top of a post by nailing down through the wood. A permanent base can be made from a coat hanger. However, this cannot be moved easily. If you do not wish to leave your weather instruments outside, you need only set up the stand. Then you can quickly set up your wind vane or anemometer to take a reading.

Can You Work Like A Scientist?

1. Can you make a simple wind vane with a pencil, thread, and a tack?

2. On the base you can write down the type of weather to expect if the wind is blowing from a certain direction. From what direction does most of the rain come?

3. Does your wind vane show the same direction as your school flag?

4. Why is the direction of the wind important to ships and planes? Can you think of an experiment that will show this?

5. Record the direction of the wind and the temperature over a period of time. What does the direction of the wind have to do with temperature?

G. Nephoscope (cloud meter)

Did you know that clouds can serve as weather balloons?

OBJECTIVES

The student will be able to:

27. name the instrument used to detect the slightest movement of the clouds.

28. construct a nephoscope.

ACTIVITIES

a. Read and study the Lab Sheet, Nephoscope.

b. Complete the Lab Sheet, Nephoscope.

Lab Sheet

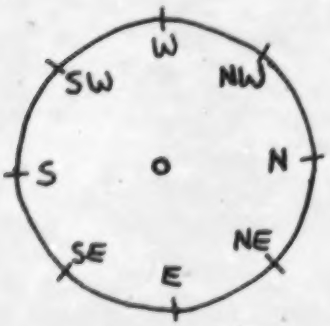
NEPHOSCOPE

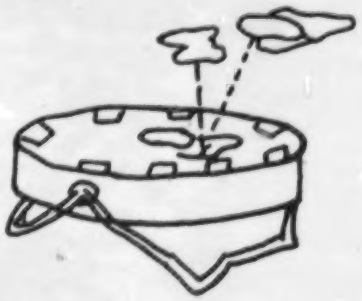
Purpose: The wind vane detects the direction of the wind near the ground. High above the earth the wind may be blowing in a different direction. The weatherman uses weather balloons to find out this information. The clouds can serve as your weather balloons. The nephoscope helps you detect the slightest movement of the clouds.

Materials: Shaving mirror with stand (found in most variety stores for 25 cents) and some gum labels or other paper.

What to Do: Type the directions on paper and glue onto the mirror as shown. Glue a small dot in the center of the mirror.

Mark directions on mirror





Watch clouds in mirror

Operation of Equipment: Set your mirror up on its stand (as shown). Turn the mirror so that north on the mirror points to north. Check your directions with a compass. Locate the tip of a cloud overhead in your mirror. Center this tip with the center dot on your mirror. Follow the movement of the cloud in your mirror. The place where the cloud moves off your mirror glass is the direction toward which the cloud is moving. Since the mirror is so small, any slight movement is noticeable on the mirror.

Can You Work Like A Scientist?

1. Since most weather reports give the direction the wind is coming from, your nephoscope readings might confuse you. Could you switch directions on your nephoscope so it will give the direction the wind is coming from?

2. Record the direction of the winds for a period of time (several weeks at least). Also record weather conditions. Can you find any connection between weather conditions and the direction of the wind?

3. Could you use the nephoscope to give you the speed of the wind high above the ground? Could you make a nephoscope that could give you wind speed? What are the problems in making it accurate?

4. Record the winds high above the ground with your nephoscope. Record the winds close to the ground with your wind vane. How often are they the same? How often are they different?

5. Could you use your nephoscope on high-flying airplanes?

6. Could you use your nephoscope to observe the movement of the sun and the moon? Why do these move across the mirror? Don't look directly at the reflection of the sun (see sunspot viewer section, page 96).

7. Record both the wind direction and the temperature over a period of time. What effect on temperature does the direction of the wind have?

UNIT OBJECTIVES

The student will be able to:

1. name the instrument used in measuring air temperature.
2. identify two types of thermometers.
3. distinguish between a degree Celsius and a degree Fahrenheit.
4. label a diagram of the liquid thermometer and explain its operation.
5. construct an air thermometer.
6. calculate the daily temperature range.
7. name the instrument used in determining the relative humidity.
8. identify the types of hygrometers.
9. construct a hair hygrometer and gather data in relation to the humidity.
10. construct a wet- and dry-bulb hygrometer.
11. name the instrument used in determining air pressure.
12. identify the types of barometers.
13. explain the differences between the mercury barometer and the aneroid barometer.
14. identify the individual that developed the mercurial barometer and describe his experiment.
15. construct a balloon barometer and measure changes in air pressure.
16. identify the weather factor measured by a rain gauge.
17. explain the use and operation of a rain gauge.
18. name the measuring units that are related to the rain gauge.
19. construct a rain gauge and measure the rainfall for a period of one week.
20. name the instrument used to determine the speed of the wind.
21. explain the use and operation of the anemometer.

22. list the units used to record the speed of the wind.

23. construct an anemometer and measure the wind speed.

24. name the instrument used to determine wind direction.

25. explain how the wind is given a name by the weatherman.

26. construct a wind vane.

27. name the instrument used to detect the slightest movement of the clouds.

28. construct a nephoscope.

This mini-course is designed to involve students in the building of weather instruments and the use of these instruments. Depending upon the class (group of students) the amount of weather data gathered and processing of this data will depend on both the teacher and the students. By the processing of data, I mean the keeping of weather charts for at least a two week period and the constructing of graphs.

INFORMATION ABOUT THE ACTIVITIES

1. The worksheets on the thermometer should be duplicated and given to each student. The materials for the construction can be obtained by the students except the glass tubing. A labeled Worksheet 2 is attached for your use.

2. The worksheet for the hygrometer should be duplicated and given to each student. The material for constructing the hair hygrometer can be obtained by the student. The material for constructing the wet- and dry-bulb hygrometer can be obtained by the student. A relative humidity table is attached for your use. The table can be made into a transparency for use with the overhead projector.

3. The Worksheet #4, Barometer, should be duplicated and given to each student. The materials for the balloon barometer can be obtained by the student.

4. The Worksheet #5, Rain Gauge, should be duplicated and given to each student. The materials for the rain gauge can be obtained by the student.

5. The Worksheet #6, Anemometer, should be duplicated and given to each student. The materials for the anemometer can be obtained by the student except for the medicine dropper or glass tubing.

6. The Worksheet #7, Wind Vane, should be duplicated and given to each student. The materials for the anemometer can be obtained by the student except glass tubing.

7. The materials for the nephoscope can be obtained by the student.

Study Sheet #2

Label the parts of a liquid therometer.

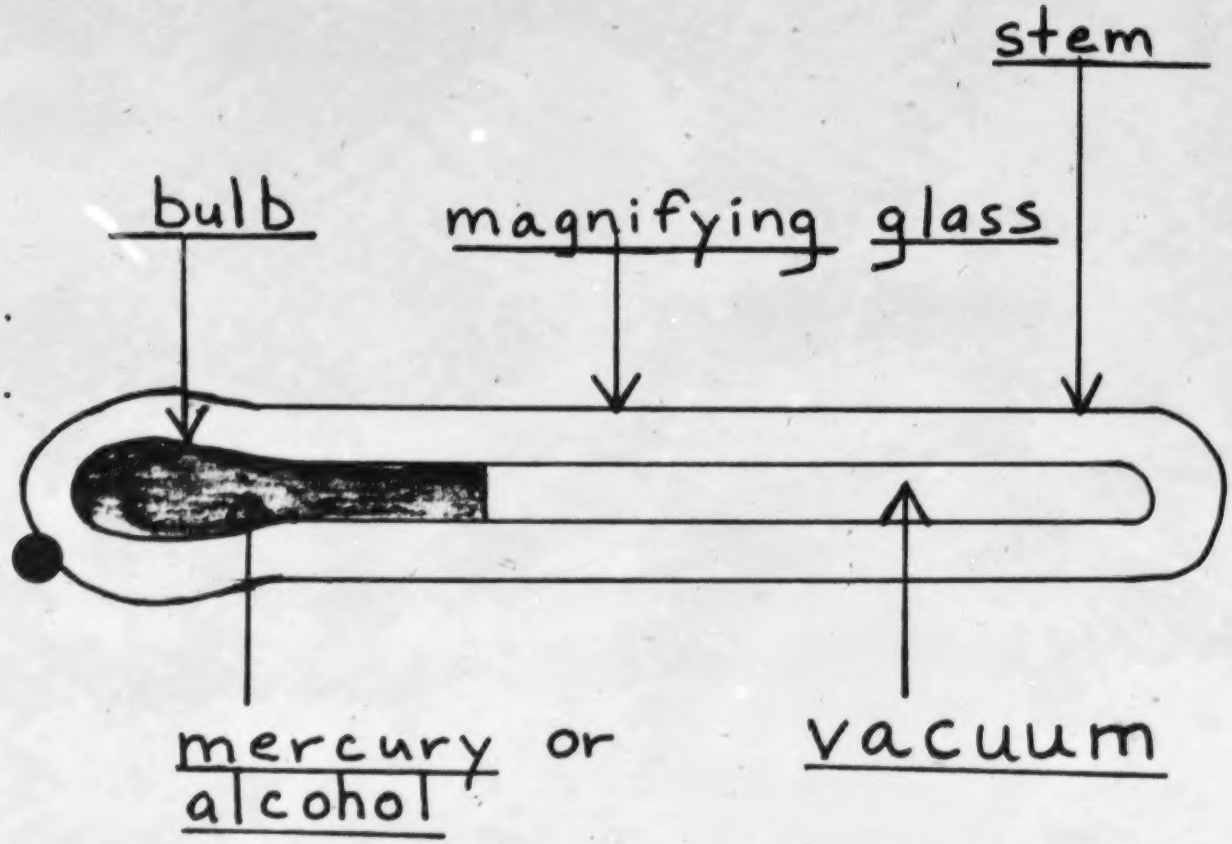


TABLE: FINDING RELATIVE HUMIDITY IN PER CENT

Difference in degrees between wet-bulb and dry-bulb thermometers.

Air Temperature (reading of dry-bulb thermometer) in degrees Fahrenheit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
30°	89	78	68	57	47	37	27	17	8																					
32°	90	79	69	60	50	41	31	22	13	4																				
34°	90	81	72	62	53	44	35	27	18	9	1																			
36°	91	82	73	65	56	48	39	31	23	14	6																			
38°	91	83	75	67	59	51	43	35	27	19	12	4																		
40°	92	84	76	68	61	53	46	38	31	23	16	9	2																	
42°	92	85	77	70	62	55	48	41	34	28	21	14	7																	
44°	93	85	78	71	64	57	51	44	37	31	24	18	12	5																
46°	93	86	79	72	65	59	53	46	40	34	28	22	16	10	4															
48°	93	87	80	73	67	60	54	48	42	36	31	25	19	14	8	3														
50°	93	87	81	74	68	62	56	50	44	39	33	28	22	17	12	7	2													
52°	94	88	81	75	69	63	58	52	46	41	36	30	25	20	15	10	6													
54°	94	88	82	76	70	65	59	54	48	43	38	33	28	23	18	14	9	5												
56°	94	88	82	77	71	66	61	55	50	45	40	35	31	26	21	17	12	8	4											
58°	94	89	83	77	72	67	62	57	52	47	42	38	33	28	24	20	15	11	7	3										
60°	94	89	84	78	73	68	63	58	53	49	44	40	35	31	27	22	18	14	10	6	2									
62°	94	89	84	79	74	69	64	60	55	50	46	41	37	33	29	25	21	17	13	9	6	2								
64°	95	90	85	79	75	70	66	61	56	52	48	43	39	35	31	27	23	20	16	12	9	5	2							
66°	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33	29	26	22	18	15	11	8	5	1						
68°	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35	31	28	24	21	17	14	11	8	4	1					
70°	95	90	86	81	77	72	68	64	60	56	52	48	44	40	37	33	30	26	23	20	17	13	10	7	4	1				
72°	95	91	86	82	78	73	69	65	61	57	53	49	46	42	39	35	32	28	25	22	19	16	13	10	7	4	1			
74°	95	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9	7	4	1		
76°	96	91	87	83	78	74	70	67	63	59	55	52	48	45	42	38	35	32	29	26	23	20	17	14	12	9	6	4	1	
78°	96	91	87	83	79	75	71	67	64	60	57	53	50	46	43	40	37	34	31	28	25	22	19	16	14	11	9	6	4	1
80°	96	91	87	83	79	76	72	68	64	61	57	54	51	47	44	41	38	35	32	29	27	24	21	18	16	13	11	8	6	4
82°	96	91	87	83	79	76	72	69	65	62	58	55	52	49	46	43	40	37	34	31	28	25	23	20	18	15	13	10	8	6
84°	96	92	88	84	80	77	73	70	66	63	59	56	53	50	47	44	41	38	35	32	30	27	25	22	20	17	15	12	10	8
86°	96	92	88	84	80	77	73	70	66	63	60	57	54	51	48	45	42	39	37	34	31	29	26	24	21	19	17	14	12	10
88°	96	92	88	85	81	78	74	71	67	64	61	58	55	52	49	46	43	41	38	35	33	30	28	25	23	21	18	16	14	12
90°	96	92	88	85	81	78	74	71	68	64	61	58	56	53	50	47	44	42	39	37	34	32	29	27	24	22	20	18	16	14

To expand this mini-course unit, the teacher might establish a weather watch by subscribing to the Daily Weather Map prepared by Washington, D.C.

Write to: Environmental Science Services
Administration, Publications Section
AD 143
Rockville, Maryland 20852

As the mini-course progresses, the Weather Lab sheet might be used to collect data.

WEATHER LAB

Date _____ Time _____

Thermometer

A. Temperature in the sun _____

B. Temperature in the shade _____

Aneroid barometer reading in inches _____

Name the type of clouds in the sky _____

Percent of the sky covered by clouds _____

Hygrometer

A. Determine the percent of relative humidity _____% R.H.

Wind speed _____ M.P.H.

Wind direction _____

Two words that describe the weather today _____

Possible forecast _____

_____

BOOKS TO BE USED WITH THE MINI-COURSE

Build-It-Yourself Science Laboratory by Raymond E. Barrett, Doubleday and Company, Inc., Garden City, New York, 1963

Pathways in Science, Earth Science 2 - Oceans of Air and Water, by Joseph M. Oxenhorn, Globe Book Company, Inc., New York, 1969

Earth Science, The World We Live In, 3rd edition, by Namowitz and Stone, D. Van Nostrand Company, Inc., Princeton, New Jersey, 1965

Modern Earth Science by Ramsey, Burckley, Phillips, and Watenpaugh, Holt, Rinehart & Winston, Inc., New York, 1969

Evaluation Form for Teachers

Name of mini-course _____

Evaluation Questions	Yes	No	Comments
1. Did this unit accomplish its objectives with your students?			
2. Did you add any of your own activities? If so, please include with the return of this form.			
3. Did you add any films that other teachers would find useful? Please mention source.			
4. Were the student instructions clear?			
5. Was there enough information in the teacher's section?			
6. Do you plan to use this unit again?			

7. Which level of student used this unit? _____

8. How did you use this unit - class, small group, individual? _____

_____

PLEASE RETURN TO SCIENCE SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE THE COURSE.

SCIENCE MINI-COURSES

	Prepared by
PHYSICAL SCIENCE	
ELECTRICITY: Part 1 (Types of Generation of Electricity)	Marvin Blickenstaff
ELECTRICITY: Part 2 (The Control and Measurement of Electricity	Marvin Blickenstaff
ELECTRICITY: Part 3 (Applications for Electricity)	Marvin Blickenstaff
CAN YOU HEAR MY VIBES? (A Mini-course on Sound)	Charles Buffington
LENSES AND THEIR USES	Beverly Stonestreet
WHAT IS IT? Identification of an Unknown Chemical Substance	Jane Tritt
BIOLOGY	
A VERY COMPLEX MOLECULE: D.N.A. The Substance that Carries Heredity	Paul Cook
Controlling the CODE OF LIFE	Paul Cook
Paleo Biology – BONES: Clues to Mankind's Past	Janet Owens
A Field Study in HUMAN ECOLOGY	Janet Owens
Basic Principles of GENETICS	Sharon Sheffield
HUMAN GENETICS – Mendel's Laws Applied to You	Sharon Sheffield
SCIENCE SURVEY	
WEATHER Instruments	John Fradiska
TOPOGRAPHIC Maps	John Geist and John Fradiska
CHEMISTRY	
WATER	Ross Foltz
PHYSICS	
PHYSICAL OPTICS	Walt Brilhart